

REMARKS

Reconsideration of the application in view of the above amendments and the following remarks is requested. Claims 2-6, 8-10, 26, 33-36, and 45-55 are in this application. Claims 2, 10, 26, and 33-36 have been amended. Claims 1, 7, 11-25, 27-32, and 37-44 have been cancelled. Claims 45-55 have been added to alternately and additionally claim the present invention.

The Examiner rejected claims 26-37 and 40 under 35 U.S.C. §112, first paragraph. Claim 26 has been amended and recites:

"a layer of isolation material;

"a first plurality of metal lines that lie in substantially a first horizontal plane, the first plurality of metal lines including first, second, and third metal lines formed on the layer of isolation material, the first, second, and third metal lines each having a top surface, a bottom surface, and side wall surfaces that contact the top and bottom surfaces;

"a first dielectric material, the first dielectric material being formed between the first and second metal lines so that the first dielectric material contacts the side wall surface of the first metal line at a point and extends horizontally from the point to contact the side wall surface of the second metal line, lying in a first region that lies horizontally entirely between the second and third metal lines so that the first dielectric material contacts the side wall surface of the second metal line, and contacting the top surfaces of the second and third metal lines; and

"a second dielectric material formed over the first region, the second dielectric material contacting the first dielectric material and having a dielectric constant different from a dielectric constant of the first dielectric material."

The layer of isolation material of claim 26 can be read to be, for example, isolation layer 312 shown in applicant's FIGs. 5B and FIG. 12B, while the first, second, and third metal lines can be read to be, for example, the left, center, and right metal lines of metal layer 316. In addition, the first dielectric material of claim 26 can be read to be, for example, the dielectric material shown in applicant's FIGs. 5B and 12B that is located between the left and center metal lines of metal layer

316, lies in a region between the center and right metal lines of metal layer 316 to contact the center metal line, and contacts the top surfaces of the center and right metal lines. Further, the second dielectric material can be read to be dielectric region 346 shown in applicant's FIG. 5B or dielectric region 736 shown in applicant's FIG. 12B.

Claim 33 has been amended and recites:

"a second plurality of metal lines that lie in substantially a second plane, the second plurality of metal lines including fourth and fifth metal lines that contact the first dielectric material, the fourth and fifth metal lines each having a top surface, a bottom surface, and side wall surfaces."

The fourth and fifth metal lines can be read to be the left and right metal lines of metal layer 324 shown in applicant's FIG. 5B, and the metal layer that overlies metal layer 316 shown in applicant's FIG. 12B.

Claim 34 has been amended and recites:

"wherein the second dielectric material is formed in a second region that lies horizontally entirely between the fourth metal line and the fifth metal line."

As shown in applicant's FIG. 5B, dielectric material 346 is formed in a region that lies horizontally entirely between the left and right metal lines of metal layer 324.

Claim 35 has been amended and recites:

"wherein the second region includes the first dielectric material such that the first dielectric material contacts the fifth metal line."

The first dielectric material can be read to be, for example, the material between the left metal line of metal layer 324 and dielectric material 346 as shown in applicant's FIGs. 5B and 12B.

Claim 36 has been amended and recites "wherein the second dielectric material is formed on and over the second region." When the second dielectric material is read to be dielectric material 346 shown in applicant's FIG. 5B, then applicant's FIG. 5B also shows that dielectric material 346 is formed on and over the second region.

Thus, in view of the above, it is believed that claims 26 and 33-36 satisfy the requirements of the first paragraph of section 112. As noted above, claims 27-32, 37, and 40 have been cancelled.

The Examiner rejected claims 7, 10, 31-33, and 43-44 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Of the rejected claims, only claims 10 and 33 remain pending. Claims 10 and 33 have been amended to add clarification (claim 10 incorporates the Examiner's comments) and, as a result, are believed to satisfy the requirements of the second paragraph of section 112.

The Examiner rejected independent claim 1 and dependent claim 7 under 35 U.S.C. §102(e) as being anticipated by Koo et al. (U.S. Patent No. 6,262,446). As noted above, claims 1 and 7 have been cancelled.

The Examiner also rejected claims 26-32 and 38-44 under 35 U.S.C. §102(e) as being anticipated by Usami (U.S. Patent No. 6,222,269). Claim 26 recites, in part,

"a first plurality of metal lines that lie in substantially a first horizontal plane, the first plurality of metal lines including first, second, and third metal lines formed on the layer of isolation material, the first, second, and third metal lines each having a top surface, a bottom surface, and side wall surfaces that contact the top and bottom surfaces;

"a first dielectric material, the first dielectric material being formed between the first and second metal lines so that the first dielectric material contacts the side wall surface of the first metal line at a point and extends horizontally from the point to contact the side wall surface of the second metal line, lying in a first region that lies horizontally entirely between the second and third metal lines so that the first dielectric material contacts the

side wall surface of the second metal line, and contacting the top surfaces of the second and third metal lines; and

"a second dielectric material formed over the first region, the second dielectric material contacting the first dielectric material and having a dielectric constant different from a dielectric constant of the first dielectric material."

In rejecting the claims, the Examiner pointed to metal line 3 (the sixth region from the left) shown in FIG. 1 of Usami as constituting the first metal line of claim 26, metal line 3 (the eighth region from the left) shown in FIG. 1 of Usami as constituting the second metal line of claim 26, and metal line 3 (the tenth region from the left) shown in FIG. 1 of Usami as constituting the third metal line of claim 26.

The Examiner also pointed to insulator 4 (between the sixth and eighth regions to the left) shown in FIG. 1 of Usami as constituting the first dielectric of claim 26. The Usami reference, however, fails to teach or suggest that insulator 4 is located in a region that lies horizontally entirely between the eighth and tenth regions to the left so that insulator 4 contacts the eighth region. Rather, as shown in FIG. 1, Usami teaches that only insulating layer 5 is present between the eighth and tenth regions from the left. As a result, claim 26 is not anticipated by Usami. As noted above, claims 27-32 and 38-44 have been cancelled.

The Examiner also rejected claims 33-37 under 35 U.S.C. §103(a) as being unpatentable over Usami. As noted above, the Usami reference fails to teach or suggest that insulator 4 is located in a region that lies horizontally entirely between the second and third metal lines so that insulator 4 contacts the second metal line. As a result, claims 33-36 are patentable over Usami. As noted above, claim 37 has been cancelled.

The Examiner rejected claim 6 under 35 U.S.C. §103(a) as being unpatentable over Koo et al. (U.S. Patent No. 6,262,446). For the reasons set forth below, applicant respectfully traverses this rejection.

Claim 6 recites, in part,

"a capacitive structure formed between adjacent metal lines of a patterned metal layer, the capacitive structure being formed from a dielectric material, the dielectric material being different from one of the layers of insulation material, the dielectric material including a plurality of layers of dielectric material."

In rejecting claim 6, the Examiner pointed to dielectric material 17b shown in FIG. 4 of Koo as constituting the dielectric material. The Examiner then argued that it would be obvious to use a plurality of layers of dielectric material because it depends on the capacitance between adjacent metal lines.

It is important to note that the issue is not whether one skilled in the art would understand that multiple layers of dielectric material could be used, but instead what would motivate one skilled in the art to use multiple layers of dielectric material. In the present example, the capacitance of capacitor 21 shown in FIG. 4 of Koo can be adjusted by simply changing the thickness of layer 17b. On the other hand, utilizing multiple layers of dielectric material is a much more complex and costly approach.

Since one skilled in the art would not be motivated to use a much more complex and costly approach when a simple approach is available, one skilled in the art would not be motivated to use multiple layers of dielectric material in lieu of dielectric material 17b. As a result, claim 6 is patentable over Koo.

New claim 45 recites:

"a first plurality of metal lines that lie in substantially a first horizontal plane, the first plurality of metal lines having first surfaces and including first, second, and third metal lines;

"a second plurality of metal lines that lie in substantially a second horizontal plane, the second plurality of metal lines having second and third surfaces, and including fourth, fifth, and sixth metal lines;

"a first dielectric material that contacts the first surfaces of the first, second, and third metal lines and the second surfaces of the fourth, fifth, and sixth metal lines;

"a second dielectric material formed between the first and second metal lines and the fourth and fifth metal lines, the second dielectric material extending from a point on the first horizontal plane between the first and second metal lines to a point on the second horizontal plane between the fourth and fifth metal lines, the first dielectric material and the second dielectric material having a different dielectric constant; and

"a third dielectric material formed between the second and third metal lines and the fifth and sixth metal lines, the third dielectric material extending from a point on the first horizontal plane between the second and third metal lines to a point on the second horizontal plane between the fifth and sixth metal lines, the second dielectric material and the third dielectric material having a different dielectric constant."

With respect to FIG. 1 of Usami, if lines 3 are read to be the first plurality of metal lines, lines 10 are read to be the second plurality of metal lines, and insulator/stopper layers 6, 7, and 8 in combination are read to be the first dielectric material, then there is no structure which can be read to be the second and third dielectric materials.

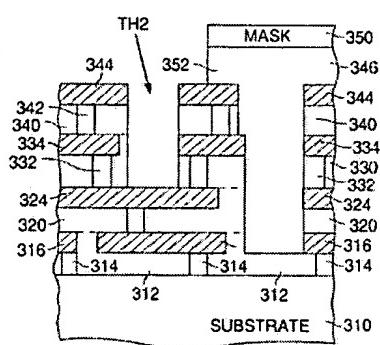
From what applicant can determine, there is no dielectric structure in FIG. 1 of Usami that extends from a point on the first horizontal plane between the first and second metal lines to a point on the second horizontal plane between the fourth and fifth metal lines where the first dielectric material and the second dielectric material have a different dielectric constant.

Further, the Usami reference appears to teach away from this. Although Usami discloses the formation of an interconnect structure, Usami further discloses a stopper layer 7 that prevents an opening from being etched completely through the intermetallic dielectric layer (for example, see column 8, lines 5-7). As a result, the stopper layer precludes trenching past multiple metal layers to form a dielectric structure that extends vertically between metal lines of different metal layers.

Thus, since the Usami reference fails to teach or suggest a dielectric structure that extends vertically between metal lines of separate metal layers, claim 45 is

patentable over Usami. In addition, since claims 46-49 depend either directly or indirectly from claim 45, new claims 46-49 are patentable over Usami for the same reasons as claim 45.

Claim 45 is also supported by the specification. As shown in applicant's FIG. 5B, which is reproduced below for ease of reference, the first, second, and third metal lines of claim 45 can be read to be, for example, the left, center, and right metal traces of metal line 344. In addition, the fourth, fifth, and sixth metal lines of claim 45 can be read to be, for example, the left, center, and right metal traces of metal line 334. The first dielectric material can be read to be, for example, dielectric layer 340.



Further, the second dielectric material can be read to be, for example, the air dielectric that exists between the left and center traces of metal layer 344, and the left and center traces of metal layer 334. In addition, the third dielectric material can be read to be, for example, the non-air dielectric that exists between the center and right traces of metal layer 344, and the center and right traces of metal layer 334. As a result, claim 45 is supported by the specification.

With respect to claims 46 and 48, the fourth dielectric material can be read to be, for example, dielectric layer 330, while the seventh and eighth metal lines can be read to be, for example, the two traces of metal layer 324. As a result, new claims 46 and 48 are also supported by the specification.

New claim 50 recites:

a first plurality of metal lines that lie in substantially a first horizontal plane, the first plurality of metal lines having first surfaces and including first, second, and third metal lines;

a second plurality of metal lines that lie in substantially a second horizontal plane, the second plurality of metal lines having second and third surfaces, and including fourth and fifth metal lines;

a third plurality of metal lines that lie in substantially a third horizontal plane, the third plurality of metal lines having fourth surfaces, and including sixth, seventh, and eighth metal lines;

a first dielectric material that contacts the first surfaces of the first, second, and third metal lines and the second surfaces of the fourth and fifth metal lines;

a second dielectric material that contacts the second surfaces of the fourth and fifth metal lines and the third surfaces of the sixth, seventh, and eighth metal lines;

a third dielectric material formed within a region that lies in the first horizontal plane between the first and second metal lines;

a fourth dielectric material formed between the second and third metal lines, and the fourth and fifth metal lines, the fourth dielectric material extending from a point on the first horizontal plane between the second and third metal lines to a point on the second horizontal plane between the fourth and fifth metal lines, the fourth dielectric material and the third dielectric material having a different dielectric constant; and

a fifth dielectric material formed within a region that lies in the third horizontal plane between the sixth and seventh metal lines, the fifth dielectric material and the fourth dielectric material having a different dielectric constant.

With respect to FIG. 1 of Usami, if lines 3 are read to be the first plurality of metal lines, lines 10 are read to be the second plurality of metal lines, insulator/stopper layers 6, 7, and 8 in combination are read to be the first dielectric

10/010,696

PATENT

AMENDMENT IN RESPONSE TO
(OFFICE ACTION DATED JANUARY 30, 2003)

material, and dielectric 5 is read to be the third dielectric, then there is no structure which can be read to be the fourth dielectric material.

From what applicant can determine, there is no dielectric structure in FIG. 1 of Usami that extends from a point on the first horizontal plane between the second and third metal lines to a point on the second horizontal plane between the fourth and fifth metal lines where the third dielectric material and the fourth dielectric material have a different dielectric constant.

Thus, since the Usami reference fails to teach or suggest a dielectric structure that extends vertically between metal lines of separate metal layers, claim 50 is patentable over Usami. In addition, since claims 51-55 depend either directly or indirectly from claim 50, new claims 51-55 are patentable over Usami for the same reasons as claim 50.

The Examiner objected to claims 2-5, 8, and 9, but indicated that the claims would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims. Claim 2 has been amended to be in independent form and are believed to include the limitations of the base claim and all intervening claims. Claims 3-5 and 8-9 have not been rewritten to be in independent form as these claims depend from claim 2.

Thus, for the foregoing reasons, it is submitted that the specification and all of the claims are in a condition for allowance. Therefore, the Examiner's early re-examination and reconsideration are requested.

Dated: 4-16-03

Respectfully submitted,
By: 
Mark C. Pickering
Registration No. 36,239
Attorney for Assignee

P.O. Box 300
Petaluma, CA 94953-0300
Direct Dial Telephone No. (707) 762-5583
Telephone: (707) 762-5500
Facsimile: (707) 762-5504